Moving People:
Busy year for builders

January 1985

RAILWAY AGE

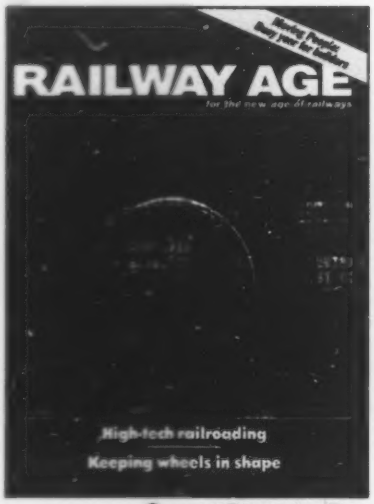
...for the new age of railways

RG0372494MAR63 20229002F713 A
ANDREA SCHWARTZ DIR
CONGRESSIONAL INFO SVC
4520 EAST WEST HWY 800
BETHESDA MC 20814

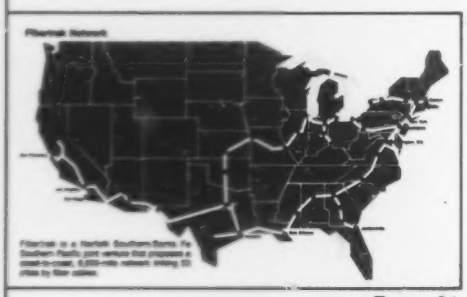
High-tech railroading

Keeping wheels in shape

RAILWAY AGE
...for the new age of railways



Cover: Photo by Roy Blanchard. *Page 27.*



Page 31.

Page 56.

Features

27 **High-tech railroading**

Now (or soon to be) working on the railroad are such space-age tools as microchips, laser beams and satellites—and there's more to come.

31 **Fiber optics: An inside track**

In both on-line communications and bottom-line profits, fiber optics will play a big role in tomorrow's railroads. The only question is how big.

36 **Just-in-time railroading**

A GTW line in Lansing, Mich., has become an extension of an Oldsmobile assembly line—or has the auto plant become an extension of the railroad?

39 **Keeping wheels in shape**

The average railroad wheel endures incredible abuse during its 250,000-mile lifetime. How can the abuse be minimized and wheel-life increased?

56 **Moving people: A busy year**

Despite the threat of more federal funding cuts, enough rail passenger activity is already under way in the U.S. to keep the wheels turning.

59 **For Transit America, a running start**

The former Budd Transit Division has a healthy backlog, a new name, and a new game plan for penetrating a greatly expanded marketplace.

Published monthly by the Simmons-Boardman Publishing Corporation, 345 Hudson St., New York, N.Y. 10014 USPS 449-130, Vol. 186, No. 1

Subscription rates to all railroad, rail rapid transit employees and industrial traffic department employees in the U.S. possessions, Canada and Mexico: $12 one year, $22 two years; all other countries $35 one year. All other subscriptions in the U.S., Canada and Mexico: $30 one year; all other countries: $50 one year. All subscriptions payable in advance. Single copies $3 plus postage and handling, except special issues. Copyrighted © 1984.

Address all subscriptions, change of address and correspondence concerning them to Subscription Dept., Railway Age, P.O. Box 530, Bristol, Conn. 06010.

Printed at Hughes Printing Co., 34 North Crystal St., East Stroudsburg, PA. 18301. Second Class postage paid at Bristol, CT. 06010 and additional mailing offices.
POSTMASTER—SEND FORM 3579 TO P.O. BOX 530, BRISTOL, CONN. 06010.

Update

21 More western coal under contract
21 FRA adopts UP's voluntary program
21 ACE project test program begins
21 Soo Line forms holding company
21 Piggy Packer weighs as it loads
22 Bethlehem tools up for longer rails
22 British company buys EMD units
23 New container car from old G85s
23 Bechtel honored for bridge
24 EMD exhibit features high-tech
24 State takes over Alaska Railroad
25 Fords move faster in BN operation
25 Conrail packages rail-barge service
25 Outlook brightens for short lines
49 West Germans fund Texas study
49 Santa Clara plan hits SP snag
49 Amtrak will test 3-phase AC
49 Vancouver orders Swiss monorail
49 New Mexico studies "rapid rail"

Comment

5 Inside
19 Watching Washington
20 Lines on Labor
47 In Transit
70 Publisher's Perspective

Departments

8 Revenues and Expenses
13 Meetings
15 Industry Outlook
16 Market Outlook
55 Advertising Sales
61 People in the News
64 Products Report
66 New Literature
67 Professional Cards
68 Classified Advertising
68 Advertisers Index
69 100 Years Ago

Inside

Welcome to tomorrow

LUTHER S. MILLER

CP Rail President R.S. Allison told the Canadian Railway Club recently that he foresees the day—perhaps 20 years or so down the road—when a train crew will consist of an engineer sitting in a control module: "In front of him would be a stop and go button. Using computers, the whole system could be programmed with such things as the track profile and the characteristics of the train. Such a train would run automatically from A to B at the most efficient fuel consumption speed, and get to B at the correct time to meet another train."

Far-out? Visionary? Actually, said Mr. Allison, "The technology for all of this exists today, but like everything else, it is likely to develop in an evolutionary fashion. But it's only a matter of time."

The time may be shorter than Mr. Allison thinks. The "evolution" of railroads into a high-tech, space-age industry is starting to look more like a revolution, with the harnessing of microprocessors to locomotives, with the kickoff this year of two major efforts to reach out into space for train control systems, with the appearance of unmanned track machines on the right-of-way—with, in fact, the whole spectrum of high-tech developments that Senior Editor Gus Welty explores in this issue's cover story.

Taken singly, not one of the dozen or more breakthroughs enumerated in this story represents what is known in the journalism trade as "hard news." But taken together, they add up to something awesome. Gus, who has been following railroad developments with an eagle eye for more than 25 years, says: "Even *I* was impressed when I began to add them all up." His story starts on p. 27.

A John Armstrong bonus issue

Associate Editor John H. Armstrong, whose grasp of the technical side of railroading is so complete that when he goes out on an interview he sometimes answers more questions than he asks, is represented in this issue by two stories. One is about a development that is beginning to be of enormous importance to railroads—the science of fiber-optic communications; the other is about something that has been of great importance to the industry for 150 years—wheel-life.

If the lightwave is really the communications wave of the future, John points out, the railroads are on an inside track to take advantage of it (p. 31).

As for wheels, John finds them to be "good soldiers, performing their multiple functions over lifetimes averaging 250,000 miles or so," and he is almost apologetic for being critical of them at all; but he does suggest that there may be ways railroads can get more out of their $550-million annual investment (p. 39).

A RAILWAY AGE SERVICE PAGE

REVENUES AND EXPENSES OF RAILWAYS

Third quarter figures of calendar year 1984

(Dollar figures are stated in thousands, i.e., with last three digits omitted)

		Operating revenues				Operating expenses												
						Way & structures			Equipment									
		Freight	Other	Total 1984	Total 1983	Total 1984	Total 1983	1984 Deprec.	Total 1984	Total 1983	1984 Deprec.	Total 1984	Total 1983	Operating Ratio 1984	Operating Ratio 1983	Income after fixed charges 1984	Income after fixed charges 1983	1984 Net Ry. operating income	Net income 1984	Net income 1983
Amtrak	3 mos.	—	204,551	204,551	193,444	21,412	37,191	(17,610)	99,641	85,939	20,258	371,878	352,912	181.80	182.43	(158,556)	(181,100)	(167,327)	(158,556)	(181,100)
	9 mos.	—	550,629	550,629	509,349	153,346	113,340	40,892	285,491	264,201	60,274	1,148,691	1,031,295	208.61	202.47	(578,790)	(579,843)	(598,062)	(578,790)	(579,843)
Atchison, Topeka & Santa Fe	3 mos.	579,210	13,262	592,472	553,848	84,885	90,891	12,867	131,197	118,934	23,777	518,213	498,090	87.46	89.93	70,030	56,176	46,907	42,439	38,800
	9 mos.	1,713,623	34,390	1,748,013	1,546,378	254,839	245,835	42,515	405,245	363,161	71,080	1,571,157	1,452,184	89.88	93.90	168,798	82,663	117,899	109,117	59,942
Baltimore & Ohio	3 mos.	250,391	10,205	260,596	234,420	45,955	64,897	9,885	56,877	49,567	7,317	247,746	241,161	95.06	102.87	9,394	(7,503)	17,620	8,130	3,650
	9 mos.	776,651	31,214	807,865	661,132	136,860	165,059	29,615	175,009	159,482	21,834	750,228	689,114	92.86	104.23	51,805	(19,048)	9,722	37,892	(12,546)
Bessemer & Lake Erie	3 mos.	18,253	6,975	25,228	18,252	4,867	4,077	1,384	4,025	2,220	1,020	18,855	15,565	74.73	85.27	6,983	3,047	3,593	4,215	1,706
	9 mos.	48,230	15,705	63,935	48,462	12,295	9,721	4,082	7,632	6,142	3,160	51,622	45,011	80.74	92.87	13,552	4,109	7,039	8,292	2,416
Boston & Maine	3 mos.	30,542	1,661	32,203	—	4,428	—	393	9,149	—	54	28,945	—	89.88	—	3,769	—	3,332	3,769	—
	9 mos.	90,697	4,611	95,308	—	13,294	—	1,188	28,000	—	162	88,519	—	92.87	—	8,911	—	7,012	8,011	—
Burlington Northern	3 mos.	1,088,995	21,335	1,110,330	1,041,289	151,765	239,806	40,306	188,402	177,445	15,222	844,332	888,965	76.04	85.37	254,520	155,913	156,796	145,308	88,304
	9 mos.	3,261,538	68,590	3,330,128	2,977,997	456,711	615,725	117,093	585,070	531,178	46,402	2,612,176	2,597,678	78.44	87.22	730,876	355,164	409,606	422,500	206,807
Chesapeake & Ohio	3 mos.	282,621	12,246	294,867	247,063	34,531	59,843	8,090	61,192	52,306	3,834	227,742	233,637	77.23	94.56	69,160	11,939	37,126	39,154	4,619
	9 mos.	816,106	30,300	846,406	705,930	107,835	150,450	24,195	184,155	155,246	10,870	696,813	654,392	82.32	92.69	204,001	37,627	85,703	140,132	19,864
Chicago & North Western	3 mos.	194,509	26,572	221,081	234,537	27,814	50,119	5,119	53,874	55,106	4,448	195,904	222,606	88.61	94.91	20,300	3,167	22,558	17,675	3,167
	9 mos.	598,238	78,243	676,481	640,393	96,236	121,561	16,512	162,193	151,736	13,310	620,290	612,014	91.69	95.56	35,629	10,703	51,403	30,854	10,703
Chicago, Milwaukee, St. Paul & Pac.	3 mos.	104,615	3,439	108,054	93,882	19,471	17,880	5,916	29,073	28,734	3,053	104,088	96,824	96.25	103.13	6,776	(1,835)	4,067	4,824	(1,182)
	9 mos.	312,808	11,021	323,829	270,466	61,052	52,752	17,723	91,779	75,675	9,098	316,108	275,216	97.61	101.75	12,712	(22,178)	7,753	11,761	2,462
Conrail	3 mos.	795,897	31,814	827,711	747,370	116,680	159,215	20,843	185,356	180,841	35,876	692,901	716,036	83.71	95.80	140,835	30,557	127,140	140,835	35,600
	9 mos.	2,445,362	93,913	2,539,275	2,231,600	364,022	448,104	63,754	569,381	548,701	106,794	2,145,686	2,148,301	84.49	96.26	410,644	73,461	371,221	410,644	90,292
Delaware & Hudson	3 mos.	30,321	1,089	32,010	29,012	5,519	5,536	213	10,394	7,806	161	32,442	29,171	101.34	100.54	(706)	(2,972)	(411)	(706)	(2,972)
	9 mos.	89,051	5,164	94,225	81,026	15,997	15,036	614	28,620	23,623	579	95,754	84,855	101.62	104.72	(2,797)	(11,911)	(1,450)	(2,797)	(11,911)
Denver & Rio Grande Western	3 mos.	90,262	1,361	91,623	80,140	13,840	13,440	4,112	17,411	16,938	3,117	80,846	75,479	88.23	94.18	10,583	3,664	7,645	7,331	2,861
	9 mos.	268,950	4,134	273,084	226,088	42,386	36,422	9,827	52,457	47,807	9,338	245,584	213,828	89.92	94.57	25,704	10,872	19,530	17,365	16,884
Duluth, Missabe & Iron Range	3 mos.	22,441	870	23,311	23,411	9,184	6,564	1,561	3,437	2,196	671	21,267	16,780	91.23	71.67	4,872	7,111	671	3,842	3,736
	9 mos.	61,914	2,911	64,825	56,287	24,002	17,253	4,703	8,557	6,509	2,078	61,606	47,257	95.03	83.98	9,749	10,378	(2,134)	5,686	5,885
Elgin, Joliet & Eastern	3 mos.	11,973	5,858	17,831	22,363	3,805	3,639	657	1,867	2,842	1,988	17,826	21,318	99.97	95.32	1,638	1,891	(412)	1,221	1,071
	9 mos.	48,151	23,874	72,025	67,783	11,271	9,745	1,972	10,508	8,507	5,898	64,331	62,322	89.31	91.94	12,572	7,783	2,759	7,637	4,284
Florida East Coast	3 mos.	25,960	522	26,482	24,137	4,014	4,881	1,127	4,668	4,355	939	21,281	20,925	80.36	86.69	9,428	5,999	1,462	5,678	3,416
	9 mos.	87,164	1,483	88,647	75,014	12,738	15,669	3,386	14,836	11,954	2,820	65,540	61,044	73.93	81.37	35,293	50,922	8,764	20,950	31,970

Grand Trunk Western	3 mos.	78,376	2,667	81,043	53,635	10,580	7,803	1,641	18,826	13,041	1,599	82,500	59,358	101.79	110.67	(3,533)	(6,703)	(215)	(2,292)	(6,025)
	9 mos.	239,537	11,815	251,352	165,673	30,837	22,551	5,137	57,352	37,231	4,808	248,631	172,771	98.91	104.28	(2,777)	(10,132)	5,968	451	(7,998)
Illinois Central Gulf	3 mos.	210,542	18,840	229,382	217,140	29,704	32,445	11,743	70,511	88,075	4,752	213,541	219,504	93.08	101.06	35,882	(11,815)	9,260	29,175	(12,195)
	9 mos.	685,942	58,949	724,891	656,654	88,920	89,182	34,784	210,521	264,295	14,767	675,164	652,869	93.14	99.43	85,871	(17,346)	29,641	68,736	(18,583)
Kansas City Southern	3 mos.	81,181	3,564	84,745	80,469	11,920	13,471	3,743	17,010	18,636	5,260	69,368	70,017	81.85	87.01	14,058	9,045	9,422	8,077	8,507
	9 mos.	236,819	11,297	248,116	232,095	36,393	41,366	11,122	56,319	54,789	15,711	209,836	205,777	84.57	88.66	32,664	21,879	25,373	19,676	17,699
Missouri-Kansas-Texas	3 mos.	67,340	4,275	71,615	54,688	15,605	9,918	2,610	16,424	13,348	1,845	67,855	51,146	84.74	88.62	3,960	662	4,177	3,863	832
	9 mos.	201,403	11,079	212,482	168,370	40,764	27,105	7,985	51,810	40,718	4,993	199,306	154,001	83.80	87.51	7,861	2,078	14,301	7,491	2,275
Missouri Pacific	3 mos.	450,611	11,866	462,477	414,789	67,832	74,074	11,823	98,312	96,408	17,784	394,818	372,887	85.37	89.89	63,830	29,729	50,909	44,555	22,155
	9 mos.	1,321,932	35,067	1,356,999	1,237,290	194,205	216,381	35,658	296,954	282,810	53,632	1,189,089	1,123,921	87.62	90.83	152,184	73,459	129,730	106,642	50,344
Norfolk & Western	3 mos.	440,341	17,906	458,247	385,307	67,871	69,893	12,023	85,803	86,005	14,280	343,685	331,774	74.99	86.10	141,427	81,836	62,838	46,157	34,335
	9 mos.	1,299,871	50,861	1,350,732	1,119,111	222,352	254,736	32,880	259,439	266,976	40,787	1,065,460	1,000,125	78.88	89.36	388,712	196,600	149,521	212,901	124,067
Pittsburgh & Lake Erie	3 mos.	12,041	832	12,873	10,095	2,444	1,328	361	2,495	4,740	359	14,147	13,757	109.89	136.27	(3,849)	(5,505)	(959)	(3,550)	(3,500)
	9 mos.	39,668	1,693	41,581	30,022	5,886	4,797	920	9,823	14,206	1,078	42,822	43,439	102.98	144.60	(9,177)	(20,549)	(919)	(0,878)	(18,544)
St. Louis Southwestern	3 mos.	105,180	1,914	107,094	96,790	14,360	15,656	4,128	29,668	24,424	6,308	101,464	91,618	94.71	95.46	5,628	3,248	7,366	4,128	3,304
	9 mos.	326,884	4,537	331,223	271,448	41,648	39,996	12,578	83,847	67,888	17,339	299,782	261,299	89.81	95.73	15,924	5,271	19,488	9,578	7,998
Seaboard System	3 mos.	660,463	14,795	675,258	609,325	89,183	107,903	16,453	169,413	155,301	15,537	587,727	577,237	87.03	94.73	82,787	20,113	62,454	54,438	19,481
	9 mos.	2,037,125	45,262	2,082,387	1,819,122	258,655	313,467	48,780	509,129	470,038	46,562	1,775,309	1,722,250	85.25	94.67	304,101	72,037	213,202	200,988	67,275
Bob Line	3 mos.	80,404	1,855	82,259	61,700	15,616	20,563	2,801	17,487	16,376	1,996	73,106	74,483	88.87	94.27	8,776	1,110	4,178	4,178	1,110
	9 mos.	232,223	5,429	237,652	214,865	49,627	49,891	8,571	53,636	48,491	6,047	220,073	224,575	87.76	94.51	13,077	3,248	12,534	12,534	3,248
Southern	3 mos.	433,527	10,625	444,152	407,475	69,025	75,090	17,282	90,329	79,055	19,310	359,986	354,616	81.05	87.02	89,976	46,153	47,533	52,033	28,429
	9 mos.	1,319,166	30,298	1,349,464	1,199,590	191,353	195,895	51,523	271,833	241,833	57,112	1,079,961	1,025,613	80.02	85.49	273,773	160,411	159,682	158,688	98,765
Southern Pacific	3 mos.	527,247	15,445	542,692	502,666	83,711	100,535	23,004	186,817	143,629	20,831	511,445	526,176	90.75	94.55	16,516	21,050	23,466	23,466	21,050
	9 mos.	1,801,462	49,469	1,850,931	1,482,232	172,341	288,006	66,269	479,510	411,776	63,096	1,642,458	1,606,971	90.4	94.5	47,580	63,150	69,198	69,198	63,150
Union Pacific	3 mos.	456,321	5,785	462,106	463,261	71,502	62,814	16,611	102,730	92,532	23,307	408,373	390,297	88.37	84.24	47,127	66,383	38,267	31,604	41,215
	9 mos.	1,414,813	18,629	1,433,442	1,330,555	214,938	202,360	50,410	320,474	273,996	70,469	1,285,917	1,190,083	89.70	89.44	135,248	132,710	102,361	89,925	83,213
Western Pacific	3 mos.	34,663*	837	37,500	37,443	7,791	6,407	729	7,039	10,245	1,766	41,088	36,825	99.4	97.5	17,286	231	3,153	3,153	1,647
	9 mos.	113,746	2,311	116,057	115,253	20,631	18,563	2,187	24,381	30,763	5,350	123,016	122,241	106.85	114.61	(16,886)	(14,655)	1,842	(7,380)	(8,000)

Source: Interstate Commerce Commission

RAILWAY AGE

Editorial and Executive Offices
New York, N.Y. 10014, 345 Hudson Street
212/620-7200 (Telex 425421 SIMB UI)

ROBERT G. LEWIS, Publisher
LUTHER S. MILLER, Editor

Managing Editor: Susan E. Avery
Special Projects Editor: Deborah Meyers
Contributing Editor: William D. Middleton
Art Director: Maurice H. Mates
Photo Editor: Roy H. Blanchard
Graphics Director: Martin Kossoy

Vice President-Sales: Charles H. Ellwanger
Vice President-Marketing: Arthur J. McGinnis, Jr.
Production Director: Carol Gilbert Jones
Production and Contract Manager: Brenda James
Director-Circulation: Cheryl A. Wieszczyk
Manager-Subscription Operations: Joyce De-Fillippi

Western Editorial Offices
Chicago, Ill. 60602, 29 E. Madison St.
312/641-5815

GUS WELTY, Senior Editor
Associate Editor: Frank Malone
Engineering Editor: William J. Semioli
Contributing Editor: Bill Fahrenwald
Editorial Assistant: Wanda Welty

Washington Office
Silver Spring, Md. 20910, 10214 Southmoor Dr.
301/593-2924

Associate Editor: John H. Armstrong

International Offices
Falmouth, Cornwall, TR11 4RJ, England
P.O. Box 8 (Telex: 45320 IRJFAL G)
Telephone: 44-326-313945

International Editors: Michael Knutton, David Briginshaw

Railway Age, descended from the American Railroad Journal (1832) and the Western Railroad Gazette (1856) and published under its present name since 1876, is indexed by the Business Periodicals Index and the Engineering Index Service. Name registered in U.S. Patent Office and Trade Mark Office in Canada.

Change of address should reach us six weeks in advance of next issue date. Send both old and new addresses with address label to Subscription Department, Railway Age, P.O. Box 530, Binstol, CT 06010 or call (203) 582-9546. Post Office will not forward copies unless you provide extra postage.

Photocopy rights: Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy articles herein for the flat fee of $2.00 per copy of each article. Payment should be sent directly to CCC. Copying for other than personal or internal reference use without the express permission of Simmons-Boardman Publishing Corp. is prohibited. Address requests for permission on bulk orders to the Reprint Editor.
ISSN 0033-8826 82 $2.00 + 0.00

Member of

Market Outlook

Equipment

Alaska Railroad: Ordered five GP49 locomotives from EMD for delivery by June 1.

Burlington Northern: Ordered 53 four-axle 3,600-hp GP50 diesel-electrics from Electro-Motive Division of General Motors for delivery in the second and third quarters of 1985. Estimated value of the order is $53 million. In a separate agreement with EMD, BN is accepting three new microprocessor-equipped, six-axle SD60 units for evaluation.

Maryland Department of Transportation: Ordered four AEM7 electric locomotives from the Electro-Motive Division of General Motors at a cost of approximately $13.6 million. The units, scheduled for delivery in the fourth quarter of 1986, incorporate ASEA technology; they will be placed in Baltimore-Washington commuter service.

Norfolk Southern: Will acquire 100 microprocessor-controlled diesel-electric locomotives in 1985 at a cost of about $129 million—50 SD-60 series units from the Electro-Motive Division of General Motors and 50 C39-8 series units from General Electric. Norfolk Southern anticipates fuel savings of 14% over conventional locomotives.

Facilities

BART: Awarded a $3.9-million contract to the DeLeuw-Foster-Francis consortium to manage construction of the $150-million Daly City Turnback and Storage Yard Project.

Southern Pacific: A planned $308-million 1985 capital program includes $213 million for track improvements. SP's '84 capital program was $360 million.

Union Pacific System: A 1985 capital budget of $578 million includes $525 million for roadway improvements, up $17 million over 1984 outlays. A $50-million equipment program includes 400 autorack cars, 200 covered hoppers, and 250 refrigerated trailers; a locomotive program is under review.

Revenue freight carloadings

Commodity	Dec. 8 week	Dec. 1 week	Nov. 24 week
Grain	28,861	30,235	24,724
Other farm products	4,840	5,526	4,132
Metallic ores	12,761	14,102	11,883
Coal	106,580	103,145	83,975
Crushed stone, gravel and sand	10,280	11,384	8,286
Nonmetallic minerals	10,432	13,294	7,041
Grain mill products	10,901	10,647	8,506
Food and kindred products	11,377	11,801	8,563
Primary forest products	12,599	13,874	9,226
Lumber and wood products except furniture	6,974	7,318	5,122
Pulp, paper and allied products	14,998	16,426	13,407
Chemicals and allied products	23,394	25,015	19,603
Petroleum products	4,878	5,162	3,706
Stone, clay and glass products	10,035	11,008	8,010
Coke	4,082	5,032	3,870
Metals and products	7,482	8,382	5,917
Motor vehicles and equipment	22,644	22,318	15,424
Waste and scrap materials	8,290	8,896	6,322
Forwarder and shipper assn. traffic	7,458	7,658	5,488
All other carloads	60,180	57,123	46,865
LCL traffic	173	184	135
Total Cars Loaded	**379,297**	**388,522**	**309,186**
% change from previous year	(2.9)	1.4	(0.7)

Estimated revenue ton-miles (billions)	1984	1983	% change
48 weeks	863.1	768.8	11.0

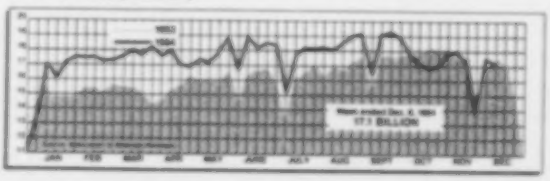
Piggyback loadings

	Dec. 1 week	Nov. 24 week	Nov. 17 week
Cars	55,143	42,935	54,967
Trailers containers	90,931	67,517	89,656

Cumulative total, 48 weeks		% change from 1983
Cars	2,485,050	14.7%
Trailers containers	4,235,777	12.4

Rail freight traffic trends

Billion ton miles (Estimated)



Freight cars

	DELIVERED			ORDERED			ON ORDER AND UNDELIVERED		
	Nov. 1984	11 months 1984	11 months 1983	Nov. 1984	11 months 1984	11 months 1983	Dec. 1, 1984	Average Backlog 1984	Average Backlog 1983
Built new by carbuilders	1,225	11,600	4,825	525	14,303	5,157	4,793	6,080	3,969
Built new in RR shops	0	0	202	0	406	3	406	165	25
Built new—total	1,225	11,600	5,027	525	14,709	5,159	5,199	6,245	3,994
Rebuilt	0	0	100	0	0	100	0	0	0
TOTAL	1,225	11,600	5,127	525	14,709	5,259	5,199	6,245	3,994

Source: American Railway Car Institute

Watching Washington

Regan tax reforms would be costly for the railroads

It was difficult, in the waning days of 1984, to find a politician or an economist who had a kind word to say about Treasury Secretary Donald T. Regan's pre-Christmas proposal for sweeping tax reforms. The effects of the proposed reforms, they were saying, would be devastating for a wide spectrum of business and industry, ranging from restaurants (the business lunch would no longer be tax deductible) to the banking and insurance industries (whose reserves would be subject to higher taxes) to such capital intensive industries as the railroads (which would lose the investment tax credit and accelerated depreciation).

"For railroads, it would just simply be bad news," said Richard E. Briggs, executive vice president of the Association of American Railroads. "It would put railroads in a real tough bind."

How tough a bind was spelled out in a Goldman Sachs Research report.

Goldman Sachs pointed out that railroads actually *paid* around 3.3% in federal income taxes in 1983, although they *accrued* federal income taxes at rates generally around 35%:

"These minimal payments among railroads primarily reflect benefits from investment tax credits and from 1981 legislation that repealed for income tax purposes the retirement-replacement-betterment (RRB) method of accounting.

"For most railroads, tax accrual rates for reporting purposes would be reduced modestly if proposed tax law changes are enacted. However, this improvement would be cosmetic; the increase in actual tax payments could meaningfully reduce cash flow. Regardless of whether the tax laws are altered, railroad cash tax payments as a percent of pretax income will begin to rise gradually over the next couple of years. However, cutting back or eliminating tax credits and stretching out depreciation schedules would significantly accelerate this trend. In the 1981-1983 period, deferred federal income taxes generated an average of $150 million annually for each of the nation's five largest railroads."

Those who feel that the railroads have been getting tax breaks beyond all the boundaries of sound tax policy and fiscal common sense should read on:

"Increasing labor costs of railroads relative to truckers have eroded the competitive position of railroads. Assisted by deregulation and modernization programs, railroads have offset higher hourly earnings expense in recent years by increasing productivity. However, these modernization programs have been spurred by the tax legislation that permitted accelerated depreciation in capital expenditures and the previously frozen asset base. A reduction in these tax benefits would increase the cost of replacing labor with capital."

Goldman Sachs finds the probability that the Regan programs will be enacted to be "low." So do most other seasoned observers in Washington. Nonetheless, the Regan rumblings were enough to turn a jolly season into a jittery one.

Major Railroads' Federal Income Tax Rates for Tax and Shareholder Reporting Purposes, 1981-1983

	Current Federal Income Tax Rate			Total Accrued Federal Income Tax Rate		
Railroad	**1981**	**1982**	**1983**	**1981**	**1982**	**1983**
Burlington Northern	(0.2)%	(0.0%	2.3%	37.7%	41.6%	35.3%
CSX	2.3	3.5	(0.1)	31.7	22.7	34.5
Norfolk Southern	12.0	10.5	7.7	31.7	31.8	35.2
Santa Fe Southern Pacific	(10.9)	3.4	8.2	32.4	31.3	36.4
Union Pacific	0.9	7.4	3.3	—	—	—

Source: Congressional Joint Committee on Taxation Goldman Sachs Research

If You Don't Have Good Track You Don't Have Good Railroad

SO... keep up to date on new developments, new practices, new materials and equipment relating to the maintenance of your railway's physical plant. Make RAILWAY TRACK & STRUCTURES part of your regular reading.

Learn more about the latest in track machinery (tampers are being computerized and some can even talk); weed and brush control; geotextiles for roadway stabilization and better drainage; fighting snow and ice conditions; bridge and tunnel maintenance; ties—wood, concrete, and steel; fastenings; direct fixation and slab track ... and *much more.*

☐ 1 year for $6
☐ 2 years for $10

Subscriptions at these rates are available only to railroad and rail transit employees in the U.S., Canada or Mexico. All other countries: $25 for 1 year. All other subscriptions: $12 for 1 year U.S.:

Name _____

Title _____

Company _____

Address _____

City _____

State/Country _____

Zip Code _____

(Please include payment with order. All orders outside of U.S. must be paid in U.S. dollars.)

Mail order to:

RT&S

P.O. Box 530
Bristol, CT 06010 U.S.A.

When these wheels leave their Griffin manufacturing plant, they are round and healthy. But what will they look like after 250,000 miles?

Keeping wheels in shape

U.S. railroads spend $550 million a year on wheels. Maximizing that investment is the goal of research into testing methods, contours and other factors affecting wheel life.

By JOHN H. ARMSTRONG,
Associate Editor

"The railway car wheel probably absorbs more punishment, endures more abuse, and suffers greater injury than any item in serving the multiple purposes of the support, guidance system, torque transmitter, and brake drum for the railway vehicle. Its enemies are numerous—slipping, sliding, sanding, rail joints, snow and ice, excessive braking, and just the plain rolling under extreme loading and high speed—to name a few."

Lewis K. Silcox's dramatization of the wheel's plight, typical of the pithy statements of this 98-year-old dean of mechanical engineers (and longtime New York Air Brake vice-chairman), remains as valid a capsulization of the situation today as when made in 1973 when he had had the advantage of only 66 years or so in the railroad business.

Acquiring and maintaining those wheels in the face of all their adversaries is expensive. Just how expensive is surprisingly difficult to determine. Even the number produced every year is a matter their manufacturers decline to announce; steel industry statistics cover only tonnage going into wheels produced by forging and rolling (51,000 tons or perhaps 120,000 wheels' worth in a very depressed 1983). Wheels replaced in railroad shops on foreign cars are well tabulated in AAR Car Repair Billing summary reports (542,000 were changed out in 1983), but wheel work on home-road cars is reported only for the roads participating in AAR's costing program. Apportioning costs between such intimately related items as wheels, axles and bearings must at best also be highly arbitrary. A slightly educated guess puts wheel costs on U.S. railroads in the $550 million a year ballpark.

Those beleaguered wheels aren't purely on the defensive, of course. Taken as a whole, the 12 million railroad wheels in the United States (97.5% of them on freight cars) have about 21,000 miles of circumference—tread and flange—with which to roll on, rub against and batter about 15 times as many miles (318,000 last year) of main-line rail. They represent 6,000,000 tons of very thoroughly unsprung weight matched against about five times as much rail. Dynamically, subtle changes in tread contour can subject vehicles to an unmerciful shaking; some lightly-loaded wheels which still look round and healthy may generate the most severe loading to which good track is subjected.

While most of those wheels are good soldiers, performing their multiple functions over lifetimes averaging 250,000 miles or so, problems (or opportunities to do better, if you prefer) are such that wheel-related research remains a major item in both FRA and AAR budgets. Problems being neither local nor technically trivial, technology has been exchanged in seven International Wheelset Congresses during the past two decades (*RA*, Nov. 30, 1981, p. 41) and an eighth is scheduled in Madrid this spring.

In taking a look at some of the directions in which improvement is being pursued, the principal ways in which wheels annoy, act up and ultimately become scrap can serve as a convenient, if perhaps undeservedly negative, framework.

• **Wearing out properly.** Ideally, all wheels should go out of service, in pairs on the same wheelset at the same time, with Code 64 or 73—"high flange" or "thin rim," respectively—in the "why made" column on the car repair billing form indicating that their treads finally were down to the condemning limit. As Table I shows, only a tiny minority do so. Some others do almost as well—a wheel whose mate was so condemned may have a little more life left but be scrapped because its rim thickness remaining is not enough to make it worth remounting on a car headed back into interchange.

More than a third of the wheels removed are in good condition. Various matters affecting the wheelset—bearing problems, minor de-

Table I

Car repair billing trends—Wheels, 1977-83

Why Made Code		1977	1980	1983
11	Removed, Good Condition	45.6	40.2	33.8
60	Flange Thin	10.2	10.7	10.1
64	Flange High	7.9	6.0	4.4
73	Rim Thin*	3.8	1.3	0.8
75	Tread Shelled	3.8	4.0	5.7
76	Tread Built Up	5.8	5.0	3.3
78	Tread Slid Flat	3.8	4.4	3.2
85	Overheated Wheel	2.5	6.5	17.0
90/99	Mate Wheel Scrapped/ Wheel Not Reapplicable	13.3	17.2	17.5
—	Other 24 Codes, Total	3.3	4.7	4.2
		100.0	100.0	100.0

*Stress relief added to rim by some manufacturers reduces number of wheels reaching "rim thin" limit before "flange high" limit.
Source: AAR interline Car Repair Billings

railments requiring bearing inspection, axle damage—require removal but they may still go on to roll out the rest of their life span in different surroundings. A steady 3-4% are slid flat, something to blame on the brakes—or the person who misused them in one way or another. Since the normal static load on a loaded wheel stresses tread metal into the plastic range and some brake shoes and conditions may generate hot spots in the 1,600-degree Fahrenheit range, the proportion of removals for spalled or built-up tread is perhaps to be expected.

"Thin Flange" removals are a secondary target of two of today's hotter items—rail lubrication and premium trucks. Greasing the flanges, a long-time approach to increasing rail life in sharp curves, may well be in the process of demonstrating fuel savings large enough to inspire its extension to long segments of tangent and moderately-curved track (and management attention improving the reliability of its application) to the extent that the life of many wheel flanges may be enhanced willy nilly.

What about radial trucks? As noted a year ago (*RA*, December 1983, p. 48), the several hundred car-sets in service have been piling up mileage to the point where flange wear reduction can be considered demonstrated—on most, but typically not all of the population. A few wheelsets persist, for reasons still somewhat obscure, in wearing their flanges thin at a "normal" rate. As pointed out in a CN report on 240,000 miles of service with DR-1 steering trucks equipped with Class C two-wear wheels, the primary significance of a two-thirds reduction in flange wear was that much less tread metal was removed in restoring flange contour for the second wear. Overall wheel life over this highly curved line thus appears likely to reach the full two-tread-life goal—on those wheels, still likely to be in the minority, which escape removal for non-wear-related reasons. Flange wear reduction certainly correlates with the radial's other selling points—reduced railhead wear and fuel saving—but grease and alloy rail remain competitive factors in the overall economics.

• Discoloration—$90 million worth. About the most overt thing a wheel can do is break and forthwith cause a derailment. Wheel problems (like many other accident causes from track and equipment failures) have been on a steady downward trend in recent years. Reportable damage of $10.9 million in 1983 is still a tidy sum, worth swinging over to net income. It is overshadowed, however, by money spent in the attempt to identify and remove thermally-abused wheels before they fail.

As heavy as the static and impact loading on wheels supporting today's 100-ton cars may be, the stresses most likely to lead to wheel failure are the aftereffects of thermal abuse. Unreleased or stuck hand and air brakes, emergency stops and "drag" braking in descending long grades generate large heat inputs at individual wheel treads. To oversimplify what is actually a complex, three-dimensional matter where other locations in hub, plate or rim may also prove critical, damage can be visualized as occurring through a process such as this:

—Rim temperatures in the range of 1,000-degrees Fahrenheit expand the wheel circumference relative to the cooler plate to which it is attached, generating compressive rim stresses exceeding the yield strength of the metal, which at that temperature has been significantly reduced.

—The hot tread and flange metal is plastically compressed. When it returns to normal temperature, the rim is now in effect too short for the circumference of the plate it surrounds. The resulting tension, if not sufficient (in combination with subsequent mechanical loads) for sudden failure, will still be there to contribute to stress reversals, the growth of fatigue cracks and ultimate failure.

Actual stresses and probabilities of failure are sensitive to dozens of variables, including wheel proportions and material properties, in addition to the number, duration and severity of thermal cycles. In general, the harder the steel the more sensitive the wheel will be to thermal damage. In the wake of a pattern of failures in long-wearing U-1 high-carbon (1.0%) wheels which had been in use on a number of 70-ton cars, the AAR had reduced the maximum carbon allowable and these wheels were being phased out in the late '70s when the notoriety resulting from hazardous material accidents resulted in a crash FRA search and destroy program to get all such wheels out of the fleet.

To remove from service wheels of any type which may have been thermally abused, AAR rules have long included discoloration of certain types and degrees as cause for scrapping. After several modifications, the current 1980 FRA rule applies to any wheel exhibiting "a pattern of reddish brown or blue discoloration from heat on the front or back face of the rim extending four or more inches into the plate area with decreasing intensity...." Previous versions differed mainly in using evidence of overheating on both faces as the measure.

Discoloration admittedly is poorly correlated with the problem, since a high heat input such as 80 braking horsepower for 15 minutes will produce drastic residual stresses but little discoloration while 20 hp for an hour will discolor but not overstress. It is something that can be inspected for, however, and in the absence of any nondestructive means for measuring residual stress went into effect.

The result has been scrapping of wheels at a rate which in the most recent reporting quarter reached 180,000 per year. At $1,000 per wheelset for material and labor costs, that's $90 million.

• Lowering those stresses. Money down the drain at that rate with no clear proof of commensurate benefit has naturally spurred the search for better approaches to the solution. For one thing, of course, better wheels could alter the relationship between thermal inputs and wheel damage.

In progress for over 20 years—more or less coinciding with the dawn of computerized finite-element stress analysis for affordably calculating the distribution of temperatures, strains and their combinations under thermal and mechanical loads in fairly complex structure—has been a shift to lower-stress wheel designs. As exemplified by the difference between the straight-plate and curved-plate designs for a 28-inch wheel, a properly contoured wheel plate can accommodate more thermal expansion at a given stress level; typically by joining the hub at a more acute angle, the plate achieves this good thing through increased "springiness" in the radial direction. In the 28-inch wheel the difference—also helpful in the manufacturing process for these desperately-needed aids to

piggyback and tri-level clearance problems—was crucial; the straight-plate wheel had so many plate failures that it had to be phased out of service. Griffin's "deep dish/curved plate" designs for larger wheels also date from this era.

Wheel manufacturers desiring to qualify wheel designs now must submit analyses, in accordance with AAR S-660 guidelines, using whatever finite-element program they prefer. WABL committee members considering approval also have available the independent calculations and recommendations of analysts at the AAR Chicago Technical Center. These analyses, derived on the basis of strain relationships assumed to remain within the elastic range—which they of course aren't in reality—have for some time been in the process of refinement to include the elaborations of elasto/plastic theory that should better describe what's going on; adoption of the advanced methodology will be based on verification by laboratory dynamometer tests.

In a joint FRA-AAR endeavor in progress over the last 16 months, more detailed data are being collected on all potentially thermally-related wheel failures actually causing derailment; this includes some incidents where the resulting damage does not bring them into the reportable train-accident category. Results to date provide some indication of how far improved designs have progressed toward the goal of a wheel of vastly reduced susceptibility to damage from thermal abuse:

Wheel Type	Proportion of Population	Failures	Discolored
Straight-plate (High-stress)	45%	56	20
Curved-plate (Low-stress)	55%	4	0

On this basis, the industry has petitioned the FRA (by authorizing monitored test use of new rules with the population consisting of all or most of the fleet) in effect to eliminate discoloration as a basis for the removal of low-stress wheels and for straight-plate wheels to return to the previous both-faces-discolored definition. Hearings are expected early this year.

• The dynamometer and other artillery. For the long haul, a multi-pronged FRA-AAR research program to define the situation to the extent that no wheel need suffer abuse beyond its capability is continuing. Some facets:

—Heat generated at the brake shoe/wheel interface and its distribution between the two is reasonably well understood, but the amount of heat removed from the wheel through its contact with the rail—calculated to be small but significant—has never been measured. The massive 450-hp dynamometer formerly at U.S. Steel's Monroeville, Pa., laboratory is now in service at the AAR Tech Center; its first test series is measuring this heat flow by pressing a nine-foot wheel (with tread contour simulating 136-pound RE rail) against the

The dynamic eighth of the car

Wheels account for about one eighth of the light weight of a freight car or about 5% of the gross weight of a freight train with an average proportion of loads and empties; those making precise calculations of train acceleration and braking must add a similar percentage to the linear kinetic energy of the train at any speed to account for the *rotational* K.E. of the wheels.

Watching over wheel matters on all cars in interchange service is the Wheels, Axles, Bearings, Lubrication ("Wobble") Committee of the Mechanical Division of the AAR, to whose specifications wheels and wheelsets in service throughout North America are built, inspected and maintained. Membership represents 15 railroads and Trailer Train (voting) plus Amtrak (non-voting).

Since 1970, wheels on U.S. railroads must meet FRA Freight Car Safety Standards (Part 215 of the Rail Safety Act) which make mandatory those design, condition, inspection and maintenance aspects considered critical to safety. With suitable adjustments (AAR wheel-flat limit is two inches, for example, to catch cars before they run afoul of the 2½-inch FRA limit with its accompanying civil dollar penalty), these match corresponding AAR Standards.

Except on a few properties (notably the Bay Area Rapid Transit) where minimizing weight by using aluminum-alloy wheel centers with separate steel tires is considered worthwhile, wheels are now steel. The long-wearing chilled car wheel, dominant in freight service for over a century, was created by casting iron in a sand mold surrounded with a metal "chill ring" which contoured tread and flange. The resulting fast but localized cooling rate created an unmachinably-hard white-iron rim grading into a soft, grey-iron center which could be bored concentric with the circumference. After a long period of evolutionary design the resulting single-plate, 850-pound wheel with spiral flange-support bracketry was at least marginally equal to structural and thermal demands in 70-ton capacity cars traveling at moderate speeds. The last cast iron wheels were phased out of U.S. interchange service by 1968, replaced by the tougher, if generally softer, steel wheels which became mandatory for all new freight cars in 1957.

Today's wheels are either wrought, using roll-forging processes developed over the many decades during which steel wheels were found primarily in passenger and locomotive service, or cast, by advanced foundry techniques developed as the iron wheels were being eliminated. On the basis of expected service, selection is made from five principal combinations of composition and hardness. (See table below.)

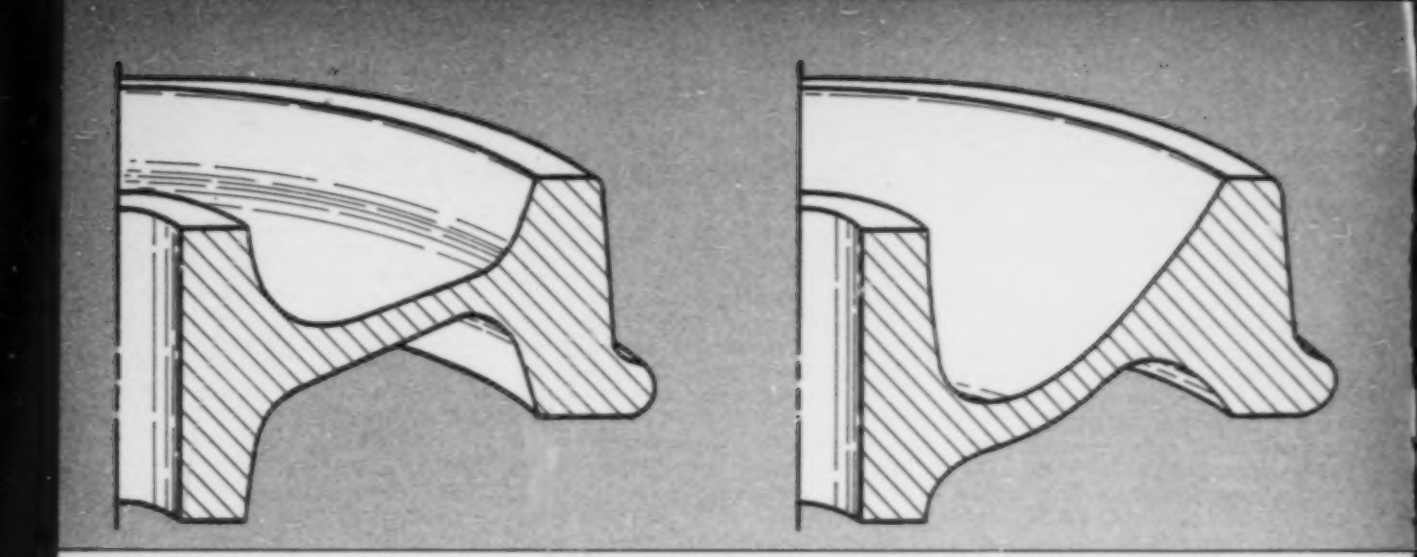
For freight service, rim thickness is classified as 1-W (one-wear), 2-W (two-wear) or M-W (multi-wear), allowing for no, one or two re-contourings for periods of extended service before tread wear ultimately leads to scrapping—if nothing else has caused the wheel to be removed from service. Lower cost per mile of service is balanced against extra initial weight (88 pounds for the 2-W, 175 pounds for the relatively rarely-specified M-W wheel).

In the interest of somewhat reduced contact stresses between rail and wheel, the long-standard 33-inch nominal diameter for all car capacities up to 70 tons (55,000-pound axle load) was increased to 36 inches for 100-ton (62,720 pounds) and 38 inches for 125-ton (78,750-pound maximum, authorized only on specific routes) nominal car capacities. Larger wheel diameters, though desirable from a track standpoint, would cause coupler-height/underframe design problems in car design as well as increasing the wheel's already considerable contribution to tare weight.

For piggyback and tri-level autorack service where car height is critical there are 28-inch wheels (70-ton nominal capacity). Diesel locomotive wheel diameter is standardized at 40 inches and passenger car at 36 inches, but transit (heavy-rail) diameters are more individualistic—mostly within the 27- to 33-inch range.

Since even these choices can result in an awkwardly large inventory of possible combinations, the AAR Committees concerned have been diligently eliminating variations wherever possible. All wheels are now manufactured to the "AAR wide" (1⅜ inch) flange configuration providing for increased wear before condemnation; 2-W or M-W wheels can then be recontoured to the "AAR narrow" (1³⁄₃₂ inch) standard for further service, minimizing the amount of tread metal that must be removed to bring the flange back into serviceable configuration.

Class	Heat Treatment	Carbon Content (Per Cent)	Rim Harndess (BHN)	Recommended Service Conditions		
				Wheel Load	Speed	Braking
U	Normalized	0.65 - 0.77	—	General Service		
L	Rim Quench & Draw	0.47 max.	197-277	Light (Passenger)	High	Extreme
A	"	0.47 - 0.57	255-321	Moderate	High	Severe
B	"	0.57 - 0.67	277-341	Heavy	High	Moderate
C	"	0.67 - 0.77	321-363	Heavy	High	Light



The straight-plate 28-inch wheel (left) had so many plate failures it had to be phased out of service. The curved-plate wheel (right) is proving that a contoured wheel plate can accommodate more thermal expansion.

wheel as various braking loads are applied at speed. In its new location the dynamometer can safely test wheels to failure as appropriate to later phases of the overall research program.

—Typically, it's not the average braking load, in repeated, emergency or drag braking, that leads to broken wheels—it is more likely to be that individual overloaded brake shoe. With the Rail Dynamics Lab's "roller rig" at Pueblo it is possible to determine the distribution of this population by actuating the braking system of a complete car-end at many speeds and feeds, and such runs are scheduled.

—Residual stress being the culprit, anyone with an idea for nondestructive means of measuring it is welcome to try—in fact, some instrumented wheels inadvertently so severely overheated that they are known to be full of stresses exist at Pueblo. However, results of past demonstrations in field or laboratory have been so dismal that this is not a primary approach. Correlations between known thermal inputs and resulting residual stress conditions by such brutal methods as measuring the results of sawing through the rim have proven most useful in the past; in combination with refined analyses and dynamometer testing to destruction, such testing will continue.

• Crucial contours. A new flange is one inch high—and, iron or steel, cast or wrought, English or metric equivalent, so it has been for 150 years with no argument. It stands taller as the tread wears down, remaining acceptable in this respect until it is 50% higher.

Settling upon and maintaining the dimensions and contour for the rest of the wheel face is something else. Tread taper and tread-flange fillet contours on the wheelset generate the conicity that keeps flange faces away from the rail heads on tangent track and at least helps the assembly move easily around curves. These contours determine the stability of the whole vehicle but they do so only as they relate to the railheads—which, like the wheel surfaces, change shape at least a little with every train-mile.

Some aspects of this matter are fairly well settled. Wheels turned to the AAR 1:20 contour running on new RE rail represent a generally stable combination, with hunting in cars equipped with standard three-piece freight trucks in most classes of service to be expected only at speeds above the economical operating range. With wear, the effective conicity of the wheel at the fillet increases and the stability of the system on tangent track decreases—to an extent that may drop the severe hunting threshold down into the operating range, as has been rather thoroughly re-examined over the last decade in connection with the Truck Design Optimization (TDOP) and Track-Train Dynamics (TTD) programs. Over most of its life in most classes of service the AAR 1:20 remains the choice, but there are problems which keep other contours popping up:

—A characteristic of the AAR 1:20 contour on new rail is two-point contact between wheel and railhead, with a band in the fillet between tread and flange not actually in contact. The resulting relatively high relative creep velocities rather quickly wear enough metal from wheel and railhead gauge corner to achieve a single-point configuration. Why not save this metal by starting out with such a "worn wheel" profile?

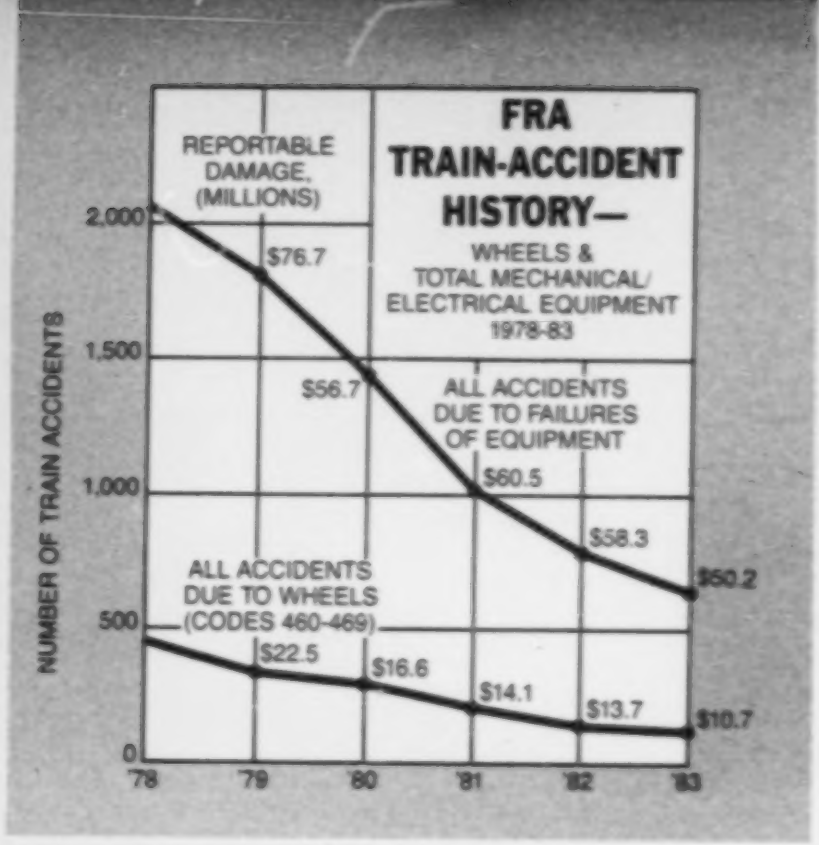
Widely used on diesel locomotive wheels is a "unipoint" modification to the AAR 1:20 intended to do just that. Another example with considerable acceptance in North American freight service is the "modified Heumann" contour developed by the Canadian National and in use on those non-radial-truck gondolas in Alberta-Pacific Coast unit-train coal hauling service which serve as the controls against which wheel wear of the DR-1 radials (above) is being compared. In general service where empty cars may travel at high speed with wheels approaching the condemning limits of tread wear, control of hunting by some combination of truck, side bearing, center plate and carbody hardware must be part of the picture and the "worn wheel" contour may not be acceptably stable.

—For situations where the utmost in resistance to hunting on the part of the wheel contour itself is considered essential, there is an alternate AAR standard cylindrical configuration in which the first two inches of tread beyond the root of a standard flange have no taper at all. Used on BART's 75-mph trains and some other transit and railroad properties, this contour of course sacrifices some of the assistance which tread taper provides toward low-friction/low-wear performance on curved track.

Significant as they may be to performance, these tread contours are so similar that it takes a sharp and practiced eye to see any difference at all, although such modern, highly automated wheelshop equipment as that manufactured by Farrel, Stanray or Hegenscheidt can rapidly restore wheels to the specified shape with a calculated minimum of metal removal.

In consideration of the impressive sums involved in wheel procurement and maintenance decisions on wheel shapes (and the somewhat related matter of tie-plate cant as it affects the mating angle of the rail surfaces), an AAR program to provide railroads and car owners with a better handle on the whole matter is under way. As discussed in a recent TTD Newsletter (*RA*, September 1984, p. 95), one possible result of the program might be a new ideal freight-car wheel contour. If (as seems more likely) no single optimum emerges, service conditions favoring one or another contour should at least become better defined. Included are tests under closely controlled conditions at Pueblo, collection of extensive data on actual rail configurations in the field and statistical analyses of the overall economics of the situation.

• The importance of being round. As the principal element of unsprung weight in the vehicle system, wheels at 900 pounds or so pose a major threat to track components—especially those in good track with its high stiffness. Just how rough wheels can be has been qualified on the Northeast Corridor with the installation of the first full-time wheel-



impact detector (*RA*, July 1984, p. 83) at Edgewood, Md. As reported at last month's ASME meetings in New Orleans, FRA/Amtrak/Battelle investigations leading up to the "Kips Machine" found some car wheels of unexpectedly out-of-round character, mostly among the "Heritage Fleet" of rebuilt passenger cars, which generated impacts of as much as 90 kips (90,000 pounds, an amplification of 5.3 times the static wheel load) at 100 mph.

Not long after the detector started identifying the individual impact load of passing axles, Amtrak's new Stanray wheel-truing equipment at its Corridor maintenance shops went into service, and axles producing impacts exceeding a 60,000-pound threshold could be given end-of-trip attention. The improvement was dramatic. The threshold has subsequently been lowered to 55,000 pounds as wheel quality in the entire passenger car fleet has continued to improve. Freshly-turned Heritage Fleet wheels, incidentally, register loads at 100 mph typically deviating only 5% from the static value.

Does this program, occasioned by the generation of hairline cracks in concrete ties by impact loads exceeding 75,000 pounds, have relevance to the freight railroad operating at more modest speeds over less high-strung track? Quite possibly so—a few freight impacts each week exceed the 102,000-pound upper limit of the detector, and a few of the most damaging wheel contours found were of a nature not condemnable by AAR out-of-round ("in excess of ½ inch within an arc of 12 inches or less with use of gauge") standards.

Without going into the identification of individual axles in freight traffic which ring up excessive impacts on the detector, Corridor engineers have been looking at impact-load data by class of train. From a preliminary survey of impact severity in 10-kip increments accumulated over 35,000 passing axles, there are indications that some consists in captive or unit-train service—where routine maintenance to higher standards might well be feasible—may currently be generating a disproportionate number of impacts at the higher levels.

• Off the track. A major endeavor of the FRA is the ongoing program aimed at track and equipment safety standards more closely tied to the factors that actually determine whether or not the wheel leaves the rail. Tests to verify analyses and determine the actual performance limits of both track and rolling stock components naturally require approaching but not passing derailment limits—except, perhaps, on the final test of a series.

In 1896, long before the Track Train Dynamics program brought "L/V force ratios" into the language of operating railroaders, French researcher M.J. Nadai promulgated a number (based mostly on wheel/rail geometry and a coefficient of friction) in the vicinity of 0.8 as the ratio of the lateral force to the vertical force on the outer leading wheel of a truck at which the flange was likely to climb the rail. As one of the ways—along with rail overturn, gauge widening and overturning—in which derailment could occur, this "Nadai limit" has been of more than casual interest to those pushing the limits of rail technology or testing.

More recently, with the aid of far more instrumentation, instances have been found in which brief L/V's as high as 2.0 didn't result in derailment. Expressions combining L/V ratios with corresponding minimum time durations which seemed to match some test results were developed on the Japanese National Railways and adapted by Electro-Motive to North American dimensions. Although dynamic analyses and scale model tests at Princeton conducted for the FRA have been unable to verify any such connection between duration and derailment, these JNR expressions have been used as test-safety guides in the absence of anything better.

Also presented at the recent ASME conference were results of a Transportation Systems Center re-examination of the matter by Herbert Weinstock. By taking into account rail forces on the non-flanging (inner) wheel as well, rail-climb expressions not involving duration of the L/V force have been derived which have checked out well with available test results. Less over-conservative than Nadal, these are expected to lead to testing with greater confidence—at the Test Center and in the field, on good, bad and indifferent track—over the broader range of conditions.

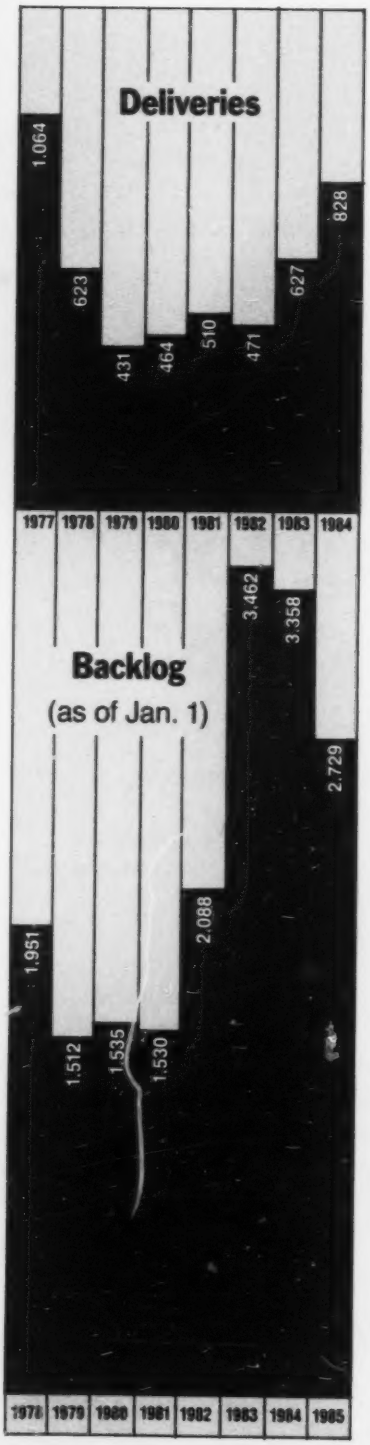
• Managing the wheel "fleet." As long as there are wheels, there will be manufacturers to turn them out. With wheels expiring more or less on a mileage/tonnage basis it would appear that fluctuations in railroad and car-owner purchases should be far less violent than in new-car orders, and until the last few years this has been somewhat true.

However, the new-car binge of 1978-79, which strained North American wheel manufacturing capacity to the limit and resulted in the import of more than 200,000 wheels in the peak year, has left a legacy of wheelsets still to be worked off before the current upturn of traffic shows up at the wheel manufacturer's plants. Both of the cast wheel suppliers—Abex and Griffin—have newly-equipped plants which have not been put into production; wrought wheel manufacturers in the U.S. and Canada number only three—Canadian Steel Wheel, Edgewater, Standard Steel—and all are working far, far below capacity.

Data keeping on the comparative performance of wheels in service has been spotty—until fairly recently, individual identifications were marked on the rim where they were easy prey to retarder shoes. Now they're on the hub or cast into the plate. Some private car owners and railroads have long since demonstrated that much closer tabs can be kept on wheels, and with profit.

By and large, shopwork maintaining those 12 million highly identical round objects in the U.S. railroad fleet has become highly centralized, mechanized, automated, efficient; as research results firm up and as mergers increasingly make "their" wheels "our" wheels, perhaps such choices as those between heat-treated and non-heat-treated wheels (for which no price differential is allowed on repair) will be made increasingly on performance bases. ■

Passenger-car market at a glance



These cars were delivered in 1984:

Purchaser	No. of cars	Type	Builder
Atlanta (MARTA)	12	Rapid transit	Hitachi
Baltimore (MdMTA)	24	Rapid transit	Budd
Buffalo (NFTA)	24	Light rail	Tokyu Car
Calgary	36	Light rail	Siemens-Duewag
Chicago (CTA)	108	Rapid transit	Budd
Cleveland (GCRTA)	22	Rapid transit	Tokyu Car
Miami (MDTA)	50	Rapid transit	Budd
	6	People movers	Westinghouse Electric/ Kawasaki
New York (LIRR/Metro-North)*	128	Commuter	Budd
New York (NYCTA)	205	Rapid transit	Kawasaki
	10	Rapid transit	Bombardier
Portland (Tri-Met)	5	Light rail	Bombardier
San Francisco (Muni)	30	Light rail	Boeing-Vertol
Toronto (TTC)	22	Rapid transit	Can Car (UTDC)
Vancouver (BC Transit)	6	ICTS	UTDC
VIA Rail Canada	50	Intercity	Bombardier
Washington (WMATA)	90	Rapid transit	Breda
Total	**829**		

*First 142 cars of this combined Metro-North/LIRR order will go to Metro-North, the remaining 174 to LIRR.

Work goes forward on this undelivered backlog:

Purchaser	No. of cars	Type	Builder
Amtrak	3	Intercity	Budd
Atlanta (MARTA)	68	Rapid transit	Hitachi
Boston (MBTA)	50	Light rail	Kinki-Sharyo
	54	Rapid transit	Can Car (UTDC)
Baltimore (MdMTA)	28	Rapid transit	Budd
Buffalo (NFTA)	1	Light rail	Tokyu Car
Caltrans	63	Commuter	Sumitomo/Nippon-Sharyo
Calgary	2	Light rail	Siemens-Duewag
Cleveland (GCRTA)	38	Rapid transit	Tokyu Car
Chicago (CTA)	270	Rapid transit	Budd
Detroit (SEMTA)	12	DPM	UTDC
Maryland DOT	11	Commuter	Sumitomo/Nippon-Sharyo
Miami (MDTA)	66	Rapid transit	Budd
	6	People movers	Westinghouse Electric/ Kawasaki
New York (LIRR/Metro-North)	188	Commuter	Budd
	39	Commuter	Bombardier
New York (NYCTA)	95	Rapid transit	Kawasaki
	815	Rapid transit	Bombardier
	225	Rapid transit	Westinghouse/Amrail
Pittsburgh (PAT)	55	Light rail	Siemens-Duewag
PATH (PA of NY/NJ)	95	Rapid transit	Nissho Iwai/Kawasaki
Portland (Tri-Met)	21	Light rail	Bombardier
Sacramento	26	Light rail	Siemens-Allis
San Diego (MTDB)	6	Light rail	Siemens-Duewag
San Francisco (BART)	150	Rapid transit	Soferval
Santa Clara (SCCTA)	50	Light rail	Metro Canada
Toronto (TTC)	126	Rapid transit	Can Car (UTDC)
	6	Rapid transit	UTDC
	52	Light rail	Can Car (UTDC)
Vancouver (BC Transit)	108	ICTS	UTDC
Total	**2,729**		

Orders likely to develop in 1985:

Purchaser	No. of cars	Type
Atlanta (MARTA)	20	Rapid transit
Boston (MBTA)	85	Commuter
Los Angeles (SCRTD)	30	Rapid transit
New York (Metro-North)	54-75	Commuter
Philadelphia (SEPTA)	50-70	Commuter
San Diego (MTDB)	10	Light rail
Toronto (TTC)	11	Light rail
Toronto (Go Transit)	40	ALRT
VIA Rail Canada	0-30	Intercity
Total	**300-371**	

The five year (1986-1990) outlook:

Purchaser	No. of cars	Type
Amtrak**	60-140	Intercity
Atlanta	0-30	Rapid transit
Boston (MBTA)	1-60	Commuter
	0-50	Light rail
Calgary	0-8	Light rail
Caltrans	10	Commuter
Chicago (CTA)	100-400	Rapid transit
Dallas (DART)	523	Light rail
Detroit (SEMTA)	0-57	Light rail
	0-20	Commuter
Los Angeles (LACTC)	44-60	Light rail
Los Angeles (SCRTD)	100	Rapid transit
New York (NYCTA)	600	Rapid transit
New York (LIRR/Metro-North)	0-146	Commuter
Philadelphia (SEPTA)	20-30	Light rail
Portland (Tri-Met)	0-25	Light rail
San Diego (MTDB)	0-10	Light rail
Vancouver (BC Transit)	20-40	ICTS
VIA Rail Canada	100-150	Intercity
Washington (WMATA)	100-300	Rapid transit
Total	**1,678-2,759**	

**1983 projection